Bookbinding and the Conservation of Books
A Dictionary of Descriptive Terminology

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glue

An adhesive consisting of organic colloids of a complex protein structure obtained from animal materials such as bones and hides in meat packing and tanning industries. Glue contains two groups of proteins: chondrin, which accounts for its adhesive strength, and glutin, which contributes jelling strength.

Animal glue is a protein derived from the simple hydrolysis of collagen, which is the principal protein constituent of animal hide, connective tissue and bones. Collagen, animal glue, and gelatin are very closely related as to protein and chemical composition. Gelatin is considered to be hydrolized collagen: $C_{102}H_{149}O_{38}N_{31} + H_2O = C_{102}H_{151}O_{39}N_{31}$ which gives an approximate chemical composition for glue of 51.29% carbon, 6.39% hydrogen, 24.13% oxygen, and 18.19% nitrogen. There may be minor variations in the composition of collagens from different sources, as well as in the composition of animal glues imparted by variations in processing techniques; however, the composition of glues and gelatins having widely varying case histories are still very similar.

As a protein, animal glue is essentially composed of polyamides of certain alpha-amino acids. It is believed that these acids are not present in glue in the free state, but rather as residues which are joined together by the elimination of water to form long polypeptide chains.

Glue is a polydisperse system containing mixtures of similar molecules of widely differing molecular weights. Because so wide a range of molecular weights is present, the molecular weight of glue is always an average, ranging from 20,000 to 250,000.

Hide and bone glues make up the two major types of animal glue. Hide glue, which is by far the superior of the two, yields a fairly neutral pH in solution, usually in the range of 6.5 to 7.4, although wider variations are possible. Bone glue is generally acidic, having pH values of 5.8 to 6.3. A glue having a high acidity absorbs less water and tends to set more slowly than a glue having low acidity. A glue having a pH greater than 7.0 tends to foam, and has a shorter shelf life than a glue that is slightly acidic.

Animal glues are soluble only in water, and are insoluble in oils, waxes, organic solvents, and absolute alcohol; however, they may be emulsified in water-oil or oil-water systems under proper conditions. One of the more interesting properties of animal glue solutions is their ability to pass from a liquid to a jelled state upon cooling, and then revert to the liquid state upon re-heating.

The important properties of glue include its jelly strength or consistency (gel strength), viscosity, melting point, adhesive strength, tensile strength or elasticity, optical rotation, swelling capacity, rate of setting, foaming characteristics, reactions to grease (whether acid or alkaline), as well as appearance, odor, color and keeping characteristics. Of these, gell strength and viscosity are most often used for determining the grade of a particular glue.

Regardless of the source of the protein, the glue manufacturing process consists essentially of washing the stock, crushing or shredding the bones or hides, soaking in a lime solution to eliminate hair and

flesh, boiling to extract the gelatinous material, gelling, and, finally, drying. The resulting hard, brittle sheets of glue are then broken into pieces or flakes, or ground into powder.

Glue as such is much too brittle for use in bookbinding; therefore a plasticizer, such as glycerin, or a less expensive substitute such asSORBITOL , often combined with glycols and tackifiers, are added to improve elasticity and resilience. These so-called flexible glues are usually prepared from high quality grades of hide glue, with the ratio of plasticizer(s) to dry glue controlling the degree of flexibility that is imparted. In addition, glue, being an organic material, is susceptible to mold; consequently preservatives, such as beta naphthol, or the safer phenols, e.g., p-phenyl phenol, are added to prevent mold and bacterial growth. Deodorants, such as terpinol, are also employed in commercial glues.

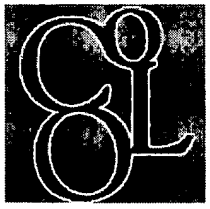
The wide acceptance of glue as an adhesive stems from its unique ability to deposit a tacky viscous film from a warm water solution, which, upon cooling a few degrees, passes into a firm jelly state producing an immediate, moderately strong initial bond. Subsequent drying provides a permanent, strong, and resilient bond.

The use of glue as an adhesive dates from earliest recorded times. Whoever discovered that a strong adhesive could be produced by cooking pieces of animal hide, or perhaps bone, in water has never been ascertained, but archeological discoveries indicate that the

Egyptians used glue more than 4,000 years ago. The practical manufacture of glue can be traced back directly to 1690 in the Netherlands. Shortly thereafter, or about 1700, the English began making glue and established its manufacture as a permanent industry. Elijah Upjohn is considered by some authorities to have been the first to manufacture glue in the United States, in 1808.

In addition to its use as an adhesive in bookbinding, glue is also used for gumming, for tub-sizing paper, and as a general adhesive in papermaking.

The term "glue" is sometimes used loosely in a general sense as synonymous with "adhesive." (6 , 102 , 184 , 185 , 191 , 196 , 222 , 233 , 309 , 335)



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